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RADIOISOTOPIC CORONARY ARTERIOGRAPHY

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Using a gamma camera interfaced directly to a high-speed digital computer, we have studied regional myocardial perfusior patterns in dynamic mode and made quantitative estimates of regional myocardial blood flow in patients after injecting various radio-pharmaceuticals via an intracoronary catheter at the time that radiographic contrast studies of the coronary arteries were being performed. The gamma camera is located in the radiographic room. The radiographic table slides under the camera detector and can be positioned in any angle of rotation without disturbing the patient.

Four studies are made routinely: left and right anterior oblipue positions for both the left and right coronary arteries. Radioactive markers on the chest wall are used to ensure proper alignment for each study. The radiopharmaceuticals employed have been ^{99m}Tc-pertechnetate, ^{99m}Tc-albumin, and ^{43}KCl. In most of our studies we have given 2mCi of pertechnetate for each injection. Recording in dynamic mode continues for about 30 seconds after injection. The total time required for the isotopic portions of the examination is about 5-10 minutes. No bad side effects have observed from isotope injection.

Computer programming enables us to generate a sequence of images in either pictorial or isometric modes, at any time interval desired. Arithmetic functions, such as background correction or addition of images representing left and right coronary flow in a single oblique position, are perfcrmed easily. Up to 16 different regions of interest can be selected from the images by means of a light pen, and time-activity curves can be generated for each region.

An index of coronary flow has been derived empirically which enables us to compare flow in one region with that in another. This index utilizes two mathematical terms: (1) cumulative activity for the first 10 seconds, corrected tor the number of data points in the region, i. e., activity/data point, and (2) rate of washout from about 5-15 seconds. The region of maximal flow is nomalized to an index of 1.0, and the flow of other regions is expressed as some fraction of that value.

We have performed studies on more than 60 patients. Of these, 4 were performed one year after cardiac transplantation, 11 were performed to assess the patency and function of coronary artery by-pass grafts, and the remainder were parformed in patients with angina or heart failure who wore being evaluated as possible candidates for surgical procedures.

In most, but not all cases, there was an excellent correlation between the isotopic and the radiographic findings. We have learned to recognize patterns representing lesions in the individual barnches of the main coronary arteries, and also to recognize the pattern of right coronary dominance. A normal isotopic study in the LAO position is characterized by a diffuse, roughly circular, uniform activity pattern, uniform flow indices in differens, regions, and fast washout rates ($T\frac{1}{2}=6-8$ sec).

Various abnormalities were seen in the majority of the patients with angina or heart failure. Of particular

interest are those patients in whom an important discrepancy was noted between the radiographic and the radioisotopic procedure :

Patients with abnormal isotopic perfusion but normal or nearly normal coronary arteriogram ——: This type of observation was made (a) in several patients with severe aortic insufficiency and marked left ventricular enlargement, (b) in several patients with previously overlooked small-vessel disease, especially involving the region of the ventricular apex ("arid apex"), (c) in several patients with angina and abnormal exercise tolerance tests, and (d) in our initial experience, as the result of a poor injection.

Occasionally a relatively small degree of arterial narrowing, e. g., less than 50%, was accompanied by a very signicant abnormality in perfusion, while in other cases, severe segmental narrowing was associated with relatively good myocardial perfusion,

Because several studies can be done quickly in a single session, the method permits one so study the effects of drugs, contrast agents, or alteration in heart action induced by pacing. Our initial data indicate that the intravenous injection of nitroglycerine results within a very few minutes in an increase in flow in all regions of the left ventricle, but especially so in the region of poorest initial perfusion. On the other hand, the injection of contrast agent may lead to a prompt and marked reduction in myocardial blood flow. For this reason, tests of the type described should probably be performed before, rather than after, the injection of radiographic dye.

A detailed study, now in progress, comparing the results of radioisotopic coronary arteriography with contrast arteriography and also taking into account all other clinical and laboratory data, is necessary before one can assess the practical value of the isotopic procedure in clinical cardiologic practice.